August Experiment Design Meeting

Paul Lee, Ev Palmer, Walt Johnson, Nancy Smith, Vern Battiste, Steve Shelden, Joey Mercer, David Wing, Richard Barhydt, Todd Eischeid, Bryan Barmore, Jim Hull

CE-11 Experiment Design

- 2 research issues
- Scenario
  - Merge 3 streams (Fever, Bambe, one from SE)
  - 2/3 traffic from Fever, 1/3 from Bambe
- Equipage – 2 levels (e.g. 75%, 25%)
- Merge complexity (easy vs. hard)
  - Examples
    - Equipped followed by unequipped
    - BBFFBB vs. BFBFBF (B=Bambe; F=Fever)
    - Few planes from the second stream
    - 3 streams merging at one point

CE-11 Scenario Details

- Recovery procedures when a controller needs to use non-speed maneuvers due to separation and TFM constraints
  - May take the plane out of the stream to another runway
    - Consensus recommendation for the scripted CE-11 problem
    - Controllers and pilots can only use speeds for spacing; May use any maneuvers for planes taken out of the stream
  - For combined CE-5/CE-11 runs, the controllers may use additional tools (e.g. base leg extension); Further discussion needed
- Constants across conditions
  - Separate wind field proposed (true vs. forecasted)
  - Variability of A/C start time at the meter fix - A/Cs start within 15 seconds of desired start time (within 2 sigma?)
  - Aircraft types (e.g. number of heavies, larges, etc.)
- Scripted CE-11 problem
  - 13 planes; 12 single piloted planes (e.g. 4 Ames + 8 Langley)
  - Approximate time: 36 minutes for the 13th plane to land
  - 18R used for scripted CE-11

CE-5 Experiment Design

- Research Issues
  - Mixed operations
  - Scalability
  - Minor flow disruptions – potentially embedded into all conditions – to be determined later
    - We need to determine procedures to handle unscripted flow disruptions
- 16 total runs – 4 repetitions per condition
- 5 1/3 days to run; 2 extra runs as make-up

CE-5 Run Schedule

- 3 runs per day
  - Currently 75 minute run with 15 minute check-in time
  - Probably need to extend the run time to 90 minutes – must work out a new schedule

Controllers & Sectors

- Each controller trained for a specific en route sector for the whole data collection
- Bowie sector may be staffed by two controllers who trade off between being over-the-shoulder observer (D-side?) to being a R-side controller
- 18R TRACON sector should NOT be controlled by a single controller

Scenario Logistics

- 8 Ames & 12 Langley single piloted planes
- Two pilot runs / scenario
- What is the real turnaround time between two pilot runs (5 min? 10 min?)
- How far must the Ames and Langley fleets from each other for non-interactions?
  - Proposal for arrivals
    - Start with 2 min staggering between Ames and Langley fleets; increase stagger time if possible
    - Note: If Ames and Langley fleet interact, system won't break down

Scenario Logistics Cont'd

- How far must the Ames and Langley fleets from each other for non-interactions?
  - Proposal for overflights
    - Avoid single piloted aircraft interactions between overflights and arrivals
    - Try to script conflicts that can occur with high probability
      - Two potential solutions
        - » Higher likelihood between two autonomous A/Cs
        - » Initial scripted autonomous-managed conflicts in the ghost sectors
    - Some metrics (e.g. scripted conflict resolution) can be considered independent sample per plane (or a pair of planes). Others (e.g. sector transit time) are dependent with other planes in the same spatial and temporal proximity.
    - What do we ask the controllers to do in autonomous-managed conflicts? Proposal – Controllers should not monitor for autonomous-managed conflicts but are not barred from taking actions on these conflicts

Scenario Design Proposal

- Start initial scenario design with Langley proposal
  - 4 sequences (all four sequences will be run in each run; pilots cycled through different sequence during the experiment)
    - Overflght/Arrival (2 Ames + 2 Langley)
    - TRACON/Overflight (2 Ames + 4 Langley)
    - Arrival/Overflight (2 Ames + 2 Langley)
    - TRACON/Arrival (2 Ames + 4 Langley)
  - Other sequences will be considered if practical constraints are too stringent
    - E.g. Arrival/Overflight combinations take the longest amount to time to finish and may be dropped if total run time is the limiting factor

Procedure Discussion Topics

- Request (assign) new RTA
- AFR arrival not meeting meter fix RTA (alt, or speed) constraint
  - Center controller – flight crew interaction
  - Center controller – TRACON controller interaction
- AFR-IFR transition at the meter fix
- TRACON / CE-11 clearance timing (at or before meter fix)
- Meter fix / runway threshold schedule relationship
  - (includes) impact of center re-sequencing on runway sequence
- Controller responsibilities & ground automation presentation of autonomous-managed conflicts
- Auto handoff, auto point out, auto-frequency transfer

- Refer to DAG Procedures.ppt document for detailed information

Potential scenarios to test the concepts

- Mixed operations
  - Overflights
    - Script complex conflicts between autonomous-autonomous, autonomous-managed, and managed-managed pairs of aircraft in proximity to other managed traffic
      - Question 1: how are managed-managed conflicts resolutions affected by proximal traffic that is either autonomous or managed?
      - Question 2: how does autonomous aircraft handle autonomous-autonomous conflicts near other managed traffic?

- Note: We will discuss other potential scenarios for concept validation in future experiment design telecons.

Metrics

- Workload
  - ATWIT and post-run ratings for controllers
  - Post-run ratings for pilots (is ATWIT-like functions possible?)
  - Should take workload correlated performance metrics to supplement and validate subjective workload ratings
    - Potential candidates for performance metrics
      - Time to accept handoff as potential workload metrics
      - Number planes that are missed handoffs prior to entering into the next sector boundary
        - » Number of handoff coordination between transferring and receiving controller
        - » Transferring controller should not let a plane enter into the next sector without next sector controller accepting the handoff
      - Number of “actions” (number of steps in tasks such as clearances)
      - Relationship between two factors: autonomous aircraft proximity (within 4 minutes?) and number of clearances by the controller under managed-managed conflicts situation
  - Averaged CPA as a comparison metric? (may collect it but unsure of its usefulness in our current scenario design)

Metrics

- Communications
  - Number and types of communications logged
- Safety
  - PK suggested post-sim questionnaire on safety for air and ground (pair-wise comparison to be used for analytic-hierarchy process)
  - Operational errors (number of separation violations and CPA)

Metrics

- Number and types of clearances across conditions
  - Example
    - For scalability, same number managed aircraft could be handled differently (e.g. lateral speed vs. altitude; number of clearances different across different level of traffic) with different amount of autonomous traffic
    - Correlation between conflicts and types of clearances
- Types of route flown across conditions
  - How many are tactical? How much deviation original flight plan? Etc.

Metrics

- Mixed operations
  - Arrivals
    - Meter fix constraints met or not met
      - » Can pilots (or controllers in managed condition) meet their constraints? (yes/no) [NOTE: controllers need to be told to meet their meter fix constraints of managed aircraft with similar precisions as autonomous aircraft]
      - » If constraints were non-conforming “how bad” did pilots / controllers miss their constraints? (categorize by 3 operational categories: minimal, medium, and large non-conformance)
  - Overflights
- Note: We will discuss other metrics for concept validation in future experiment design telecons.

Misc Questions

- Under managed condition, can single piloted planes be given an RTA clearance (instead of speed clearance) which can be met using variable speed?
  - Recommended solution: Give both options (speed and RTA) to the controller and let them choose between them